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J. Lamb / 1034A

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Report of Material Release

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Date document received

Signature

Jennifer - This was in the stack of docs. you requested but I could not find a request form; therefore, I assumed you wanted the document. And I prepared this Bryan.

Repository No. 2951

D. C. Worthington

[redacted]

K/CR-734/DEL

CARBIDE AND CARBON CHEMICALS COMPANY
K-25 Plant

Oak Ridge, Tennessee
October 13, 1952

To: Mr. K. W. Bahler
Mr. E. C. Bollinger
Mr. Sylvan Cromer
Mr. G. H. Dykes
Mr. A. P. Huber
Mr. W. B. Humes
Dr. F. W. Hurd
Mr. J. A. Marshall
Mr. E. A. Pluhar
Mr. D. H. Rader
Mr. W. L. Richardson
Mr. M. F. Schwenn

From: Safety and Protection Division

Subject: Report of Material Release

Date of Incident: October 6, 1952
Nature of Incident: Ruptured Cold Trap
Location K-1131 Feed Plant

Carbide and Carbon Chemicals Company, Operating Contractor for the U.S. Atomic Energy Commission.

During the normal heating of a Size 1, Kellex-Type Cold Trap in the K-1131 Feed Plant for the purpose of vaporizing UF_6 to be used as plant feed, a small rupture of the outer wall of the trap occurred, resulting in the release of approximately 50 lb. of gaseous UF_6 to the atmosphere. The trap was immediately vented to the recycle system, the calrod heaters shut off, and the trap CO_2 cooling system was activated to freeze the material remaining in the trap. The release stopped in less than a half-hour, but final settling of the material released required an additional half-hour. As a result of the increased pressures in one of the recycle pumps, a gasket was forced out and a fire started by the reaction of the hydrocarbon pump oil with a small amount of fluorine in the system. The fire was brought under control by use of CO_2 extinguishers by the time the principal hazard due to the material release had ceased.

FINDINGS

1. The operations at the time of the release were as follows:

   (a) Normal operation requires alternate heating of the trap and the draining of the liquid UF_6. The trap had been partially drained during the preceding shift, and the drain procedure was continuing with the trap being heated at the time of the release.

   (b) The trap was being operated under usual conditions at a skin temperature of approximately 275°F. and a pressure of 45 lb. psig. as shown by trap instrumentation.

   (c) [redacted] a cold trap operator, was at the control station preparing to connect another filled trap to the feed line. When he saw that material was escaping from the ruptured unit, he disconnected the heaters, vented the trap to the recycle system, valved in the CO_2 cooling system, and evacuated.

This document has been approved for release to the public by:
Technical Information Officer
Oak Ridge K-25 Site
Date 6/14/96

[redacted]

[redacted] INFORMATION

Classification changed to: UNCLASSIFIED
(level and category)
Thomas W. Jelley 5/24/96
ADC or ADD signature (first reviewer) Date
ADD signature (final reviewer) 5/24/96 Date

(d) The evacuation alarm was sounded from the control room and employees were immediately evacuated from the building.

2. The abrupt release of the gaseous contents of the trap to the recycle line forced out a gasket and seal of one of the recycle pumps, permitting the hydrocarbon oil used for lubrication to come in contact with the small amount of fluorine which is normally in the recycle system. The resultant reaction produced a fire which burned off the insulation of the pump control wiring and damaged other parts of the pump. The Fire Department was called to deliver additional large CO_2 fire extinguishers to this location and to give standby assistance while the fire was extinguished by the operators using CO_2.

3. The following information concerning the present use of the cold trap is considered significant:

(a) This trap was one of those which was originally designed to be used for cascade purging operations which would have involved only slow accumulations of material as a result of process difficulties and slow release to the cascade later. Thus, they were designed for an operating temperature of 160°F. (176°F. skin temperature) and a 40 psig. operating pressure.

(b) The original "triple-pass" design of the cold trap called for heating units inside the trap as shown on the diagram of the cross section of the trap. However, the original vendor of these heating units has encountered difficulty in meeting the specifications so, despite the fact that such units have been on order since November 1951, none have been delivered. As a result of the recent increased use of these heaters caused by their usage in phase II of Feed Plant operations, the plant reserve has been exhausted and in September 1952 it became necessary to devise a substitute heating method which involved doubling the number of heating units placed outside the trap.

(c) On September 5, 1952, before installation, the trap was given the specified pressure test, which included a 60 psig. air test of the shell which failed.

4. The present heating cycle requires approximately 4 to 5 hours to remove all of the contents of a filled trap. Under normal operation, a trap will receive the manufactured feed until it plugs, at which time it will contain approximately 1200 lb. of UF_6. It is then heated with resultant liquefaction of the UF_6, and drained.

5. Comments concerning available relief devices are as follows:

(a) As installed, the trap has a relief valve and a safety diaphragm connected in series in a line between the trap and a surge drum. However, the safety diaphragm had previously failed, indicating a previous pressure difference between the trap and the tank greater than about 45 psig., and both the relief valve and the diaphragm had been valved out; the same condition was true of several other of the traps in the building.

(b) The safety diaphragms on the surge tank were designed for a maximum pressure of 50 psig. with respect to the atmosphere. Thus, if the pressure in the tank were 10 psig. above atmosphere, a pressure in the trap of 55 psig. would be needed to rupture a safety diaphragm set for 45 psig.

(c) Overpressure alarms were available. However, due to frequent operation above the alarm pressure of 40 psig., these were disconnected from all traps.

6. Any HF which may have been in the trap was not considered to have been a causative factor in this rupture.

7. The rupture consisted of a 1-1/2" long longitudinal crack under one of the clips holding one of the original calrod heating units close to the trap surface. Although the original specification had required a thermal insulator between the calrod unit and the clip, such insulation had not been applied in this case. Also, the clip was designed to hold the heater approximately 9/16" from the trap surface, but inspection at the time of discovery of the crack indicated that in some way it had been so pinched that the calrod was in contact with the trap shell. The description of the calrod units included a surface temperature specification of about 500°F.

8. No deformation was noted at the site of the rupture of the trap shell.

9. It appeared to the committee that this material release resulted primarily from metal failure caused by continued operation under conditions of temperature and pressure exceeding design specifications, and that the immediate cause of the rupture was the strain caused by highly localized heating at one point due to the uninsulated heater in contact with the trap shell. It was not possible to establish immediately whether the break was primarily due to stress rupture resulting from a highly localized increased pressure in this area due to the expansion of a small volume of material as it was liquefied; to metal fatigue produced by the high temperature and cooling cycles; or to stress corrosion accentuated by the above factors. It was planned, however, to make analytical determinations of these factors when the trap was completely evacuated.

10. The first air samples of the release were taken at about 2:15 a.m. and periodically from that time until about 10:30 a.m. The air was found to be below the P.A.L. in the plant control room, slightly above the P.A.L. on the mezzanine floor where the pump which failed was located, and well above the P.A.L. in the cold trap room. Most of the employees working in the cold trap room or on the mezzanine wore protective equipment.

11. Clean-up operations began about 1:15 a.m. and continued until after 8:00 a.m. by which time only the mezzanine was significantly above its normal contamination level.

12. Fourteen employees involved in the release were sent to the dispensary for supervisory checks, but no clinical evidence of injury due to this incident was observed.

13. The material remaining in the cold trap was removed over the next few days after the incident.

RESPONSIBILITY

The investigating committee consisting of B. H. Thompson of the Chemical Division, W. J. Hamer of the Engineering Division, and G. S. Storer and H. F. Henry of the Safety and Protection Division assigned the following responsibility for the release:

50% 5-4 In that the equipment was operated under more stringent conditions than those for which it was designed, and available safety devices were not used.

50% 2-1 In that the equipment was approved for use in an operation where the requirements considerably exceeded specifications.

RECOMMENDATIONS

1. New traps capable of meeting the requirements of this operation should be designed and procured.

2. A method for maintaining a more uniform pressure in the surge tank should be devised and provisions should be made to prevent an excessive amount of material from being accumulated in it except for emergency operations.

3. Design specifications should be met during all maintenance operations.

4. Where possible, the remaining similar traps should be checked to determine if strains indicating incipient metal failure have been set up, and if so, appropriate action should be taken.

5. Excessive pressures in the cold traps should be controlled by the use of safety diaphragms and more frequent maintenance of relief valves.

6. Until new traps become available, the time cycle involved in feeding the contents of a trap to the cascade should be increased by reducing the rate of heat input.

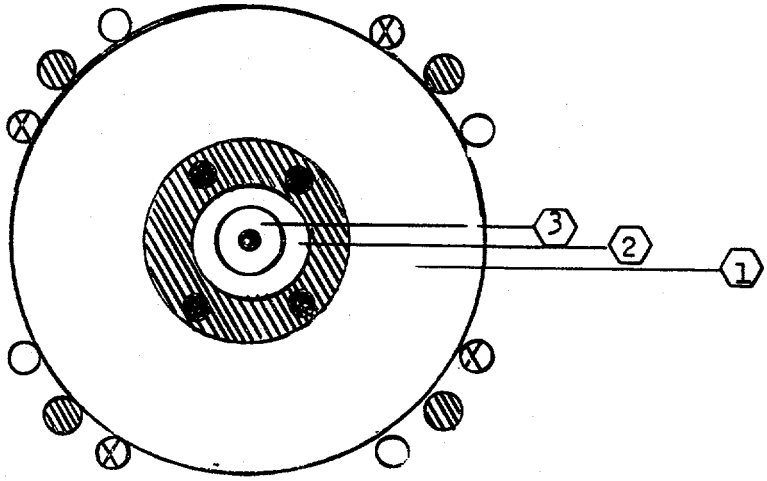
Hugh F. Henry

H. F. Henry
Safety and Radiation Hazards

HFH:lja

cc: Mr. W. J. Hamer
Mr. B. H. Thompson
Mr. G. S. Storer
Safety Department File - K25RC

GROSS SECTION VIEW OF COLD TRAP



Legend

○ Heaters normally available

● Location for unavailable heaters

⊗ Substitute heaters

▨ CO_2 used as coolant

① ② ③ Space for condensing UF_6

Note: Heater and cooling tube are inside #3 UF_6 space